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**Programming Is Hard – Or at Least It Used to Be: Educational Opportunities and Challenges of AI Code Generation**

**Keywords specific : AI (Artificial Intelligence)**

AlphaCode, Amazon, code generation, CodeWhisperer, Codex, GPT-3 (language model), introductory level programming, LLM (large language model), OpenAI

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The document highlights the educational opportunities and challenges associated with code generation using artificial intelligence, focusing on the area of programming education. It mentions that several AI-based code generation tools have recently become available, and that they present both opportunities and challenges for programming education. The paper also discusses the impact of these tools on the teaching of computer science curricula and on the learning of programming, showing that these tools have the potential to significantly change the way programming is taught and learned. The document also talks about the importance of rapidly communicating these new developments to the computer science teaching community in order to adapt to the development of these tools as soon as possible.

The historical context of AI code generation is also addressed in this document, highlighting recent advances in this field with the availability of several tools: such as OpenAI Codex, DeepMind AlphaCode and Amazon CodeWhisperer. These tools are presented as having the potential to make programming more productive and accessible, while addressing a number of challenges associated with their use, such as security, the impact on education and the potential risk of misuse. The paper discusses the impact of these tools on the teaching and learning of programming, highlighting the potential changes in the way programming is taught and learned, as well as the multiple opportunities and challenges they present.

In addition, the paper explores the rapid evolution of AI-based code generation tools, highlighting the potential impact of these advances on the teaching of programming and the learning of computer science students. It highlights the fact that students can now easily generate code solutions for their practical work and assignments using AI-powered tools. This apparent ease of code generation raises questions about the future of computing courses and how these tools will affect the delivery of computing education programmes.